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Original article

# Earthquake-related psychological distress and associated factors 4 years after the Parnitha earthquake in Greece

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**Abstract**

Exposure to earthquakes has been associated with psychological distress and in particular the development of post-traumatic stress disorder (PTSD). Earthquake-related psychological distress can be longstanding. The present study involved 157 Greek survivors of the 1999 Parnitha earthquake assessed approximately 4 years after the earthquake. Assessments were based on the Traumatic Stress Symptom Checklist (TSSC). Using stringent calibrations for the estimation of symptom presence 25% of the survivors endorsed at least 5 and 12% at least 10 TSSC symptoms. Approximately 22% of the survivors reported subjective distress and 15% impaired adjustment due to their symptoms. Intensity of fear during the earthquake and participation in rescue operations related to greater post-earthquake psychological distress. The results suggest that the psychological consequences of earthquakes can be serious and long-standing even when the magnitude of the earthquake is moderate. Psychological treatments that have been proven to reduce fear and PTSD symptoms need to be made available to the survivors. Such treatments may also increase the survivors' psychological preparedness and emotional resilience in view of future earthquakes.
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## 1. Introduction

Earthquakes are life-threatening, unpredictable and uncontrollable phenomena that can cause widespread devastation and expose thousands of people to sudden bereavement, injury, loss of property, homelessness, and displacement [27,29,30]. Although years of research have linked post-traumatic stress disorder (PTSD) to life-threatening [26], uncontrollable and unpredictable stressors [5], the prevalence rates of PTSD in communities exposed to earthquake have only recently started to attract the attention of researchers worldwide.

The results of several studies suggest that PTSD symptoms are common in earthquake survivors [7,13,19,24,28]. A community study reported 50% lifetime PTSD in survivors of the 1988 earthquake in Armenia [1]. In two other epidemiological studies [2] of survivors of the 1999 earthquake in Turkey, current rates of PTSD for those living at the epicentre and those at a 100 km distance from the epicentre were 23% and 11%, respectively. These studies had the advantage of involving large probability samples and basing their estimation of PTSD on structured diagnostic interviews [1] or validated diagnostic instruments [2].

Powerful earthquakes that cause thousands of casualties can have long-term psychological consequences [20,35]. Nevertheless, relatively little is known about the long-term psychological effects of less powerful earthquakes (i.e. earthquakes of lower magnitude and less related casualties). One study [14] that based its results on survivors of the 1989 Newcastle earthquake in Australia (magnitude of 5.6 Richter, 13 deaths) reported that 48% of the survivors who scored high on symptoms of traumatic stress and depression 6 months post-earthquake still had similar symptoms when they were reassessed 2 years later. These findings suggest that even moderate-intensity earthquakes can lead to long-standing problems in some survivors.

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The notion that the extent of disaster-related psychopathology is positively correlated with the number of fatalities caused by the disaster [34] has been recently challenged by studies [7,24,35] which showed that the intensity of the survivors' fear during the earthquake is the strongest predictor for PTSD, over-and-above devastation and casualties caused by the earthquake. These results suggest that even earthquakes of relatively low magnitude can cause PTSD to people who experience them with high levels of fear. Indeed, this may explain why the estimated rate of PTSD in people who had high exposure to the 1988 Newcastle earthquake was 18% [13]. The intensity of the survivors' fear during the earthquake and its relationship with PTSD need to be further explored especially in groups of survivors who experienced earthquakes of relatively lower intensity.

Other commonly reported risk factors for earthquake-related psychopathology include the level of exposure to earthquake, such as exposure to actual or threatened injury during the earthquake [14], proximity to the earthquake's epicenter [1,19,20], and damage to house or material loss [11,18,22,25]. Finally, earthquake-related psychopathology may also relate to female gender [7,13,21,33,36], lower education [7,15,21], and a personal history of emotional problems [7].

The literature comprises only a few studies of the psychological status of Greek earthquake survivors, despite the fact that Greece is an earthquake prone country. One of these studies was conducted 2 weeks after the 1986 Kalamata earthquake [32] and involved tent-residents, students, and outpatients of a general hospital in the epicentre region. The results suggested that 31% of the tent residents, 12% of the students, and 41% of the outpatient survivors had 'severe psychophysiological disturbance' according to self-rated scales. The respective rates of depressed mood in the three groups were 79%, 69% and 75% [32]. In another study [10] of survivors of the 1981 Alkyonides earthquake, those who were still living in tents 2–3 months post-earthquake reported (retrospectively) greater fear and physiologic reactions during the earthquake. In a more recent study [9] of 91 survivors of the 1995 Egion earthquake acute stress reactions were found to persist 3–10 days after the disaster.

The above studies had methodological limitations (e.g. small sample size, lack of valid diagnostic measures for PTSD or depression, lack of probability samples or control groups). In addition, they were conducted either within the acute post-earthquake phase [9,32] or within the first 3 months post-earthquake [10]. Despite their limitations, the studies suggested that at least some earthquake survivors in Greece may experience psychological distress soon after an earthquake, without providing any information about the survivors' psychological responses to earthquake in the long run.

The present study was based on survivors of the 1999 Parnitha earthquake in Greece. The study aimed at contributing to the existing knowledge in the field by involving survivors of an earthquake of relatively low intensity that were assessed several years after the earthquake. In addition, the design allowed us to explore for the first time the relationship between fear and post-traumatic stress in a group of survivors exposed to an earthquake of relatively low intensity. We hypothesised that (a) PTSD symptoms will be common in the survivors, and (b) fear during the earthquake will be the most important predictor of PTSD symptom severity.

## 2. Method

### 2.1. The Parnitha earthquake

On the 7th of September 1999 an earthquake measuring 5.9 on the Richter scale hit Athens. The epicenter was mount Parnitha, at approximately 3 km from the municipality of Aharnae (broader Athens area). The most heavily damaged area lied within a radius of 12 km from the epicenter, which is inhabited by approximately 1 million people. The earthquake caused 143 deaths, 700 reported injuries, and homelessness for approximately 40,000 families [31].

### 2.2. Participants

The study group was a convenience sample of 157 adult survivors: 67 (43%) of them were drawn through consecutive home visits in the areas of Aharnae that had been most damaged by the earthquake and 90 (57%) through 'linkage sampling' [17] in areas of Athens that had high exposure to the earthquake (e.g. in the municipalities of Zefyri, Ilion, and Nea Philadelphia). 'Linkage sampling' involved first drawing up lists of potential study participants, based on the information from various 'key informants,' including the interviewers and their friends. Attempts were then made to contact all listed survivors. Once the interview was completed, each survivor was asked to list all friends or acquaintances with high exposure to earthquake.

From the 241 adult survivors who were approached and asked to complete the screening battery 79 (33%) refused to participate in the study. The main reasons for refusal were (a) "not interested", (b) "too busy—no time", and (c) "too painful to talk about the earthquake, do not want to think about it". The relatively high refusal rate mainly reflects a judgment error on our part in the choice of time (lunchtime) and day (school-day) of the first few days of screening. At lunchtime and on a school day the households were busy preparing their children to go to their afternoon classes at school, and thus declined to be screened. In addition, some of the survivors that declined to participate saying that they were not interested or that they were busy may have actually been avoidant of talking about the earthquake because this caused them discomfort. This may have led to an under-representation of the symptomatic survivors in the sample.

Out of the 162 survivors screened, 5 (4%) were excluded from analyses for various reasons (e.g. psychotic problems, insufficient command of the Greek language, and cognitive or physical impairment interfering with the screening).

Out of the 157 survivors who were included in analyses, 140 (89%) were drawn from the community and 17 (11%) from two prefabricated housing sites in the same municipalities.

Regarding psychological help sought post-earthquake (between September 1999 and the date of the screenings) we were able to obtain data on 122 (78%) survivors. Fourteen survivors (10%) started visiting a mental health professional and/or using psychotropic medication after the earthquake. The reasons for seeking help were mainly anxiety or depression due to bereavement that was unrelated to the earthquake ($n = 2$), family and relationship problems ($n = 2$), alcoholism ($n = 1$), other reasons ($n = 7$), or undisclosed ($n = 2$).

### 2.3. Measures

Screenings were based on the 'Screening Instrument for Traumatic Stress in Earthquake Survivors' (SITSES) [8]. The SITSES is a brief self-rated instrument that consists of three parts: (1) the 28-item Survivor Information Form, which concerns demographics, personal and family history, trauma characteristics, and intensity of fear during the earthquake (rated 0 = none, 1 = mild, 2 = moderate, 3 = severe, 4 = extremely severe), (2) the Traumatic Stress Symptom Checklist (TSSC), which consists of items tapping the 17 PTSD symptoms (according to DSM-IV) and six depression symptoms, all measured on an intensity scale (rated 0 = not at all bothered, 1 = slightly, 2 = fairly, 3 = very much bothered), and (3) the 3-item Severity of Disability Scale (SDS), which measures the global severity of subjective distress and the degree of social or occupational impairment due to symptoms (both rated 0 = not at all, 1 = slightly, 2 = fairly, 3 = extremely), and request for psychological help for symptoms (0 = no, 1 = yes, 2 = not sure).

The TSSC was previously validated on 130 earthquake survivors in Turkey [8]. When symptom presence was determined by an item score ≥2, the items showed optimal sensitivity and specificity. In the present study two different symptom calibrations were used to estimate symptom-presence: (a) a symptom was considered present if rated ≥1 ('slightly bothersome' and higher), and (b) a symptom was considered present if rated ≥2 ('fairly bothersome' and higher). In addition, although the validated version of TSSC enquires about the severity of symptoms 'in the last week', given that our study aimed at the identification of chronic problems, the time-frame in the present study was changed to address symptoms 'in the last month'.

### 2.4. Screenings

Screenings were conducted approximately 4 years after the earthquake by the first author and five volunteer psychologists from the Behaviour Therapy Unit of Athens (Center of Mental Health). The psychologists had received intensive training by the first author in the assessment of earthquake-related PTSD. Although the SITSES is a self-rated measure, the psychologists were instructed to read out the items to the survivors whenever there was a need (e.g. the survivor had literacy problems or problems with eyesight). All participants gave their verbal consent for participation in the study. At the end of each screening, survivors who had psychological problems were offered referral to appropriate psychiatric outpatient clinics.

## 3. Results

### 3.1. Demographic and trauma features

The majority of the participants were women ($n = 96$, 61%) and married ($n = 97$, 63%). The mean age of the sample was 41 years (SD = 15) and the mean time lapsed between the earthquake and the screening was 45 months (SD = 1). Thirty-seven survivors (24%) had primary, 25 (16%) secondary, 50 (32%) high school/lyceum, and 42 (27%) university or post-graduate education, whereas two (1%) had no schooling. Seven survivors (5%) had a history of psychiatric illness prior to the earthquake and 11 (7%) reported history of psychiatric illness in their family.

Most survivors experienced the earthquake in a building, whilst a minority ($n = 17$, 11%) were in a car or in the street when the earthquake occurred. Although the majority of the survivors ($n = 114$, 75%) reported 'no' or 'mild' damage to their homes during the earthquake, 24 (16%) reported 'moderate' or 'severe' damage, and the homes of 14 (9%) either collapsed or were demolished after the earthquake because of extremely severe damage. Among the 124 survivors (80%) who received an official damage estimate for their homes from the authorities, 35 (22%) received a marking of 'green-no damage', 69 (44%) of 'yellow-some damage', and 30 (19%) of 'red-serious damage'. At the time of the screening 102 survivors (65%) were living in the same house that they used to live when the earthquake took place, whereas 36 (23%) in a new house/apartment, and 17 (11%) in a prefabricated house. Fifty-four survivors (35%) reported material loss as a result of the earthquake, 20 (13%) participated in rescue efforts, and one survivor (1%) had been trapped under rubble. With regards to bereavement, no survivor lost a first-degree relative and only two (1%) lost a second-degree relative, but 33 (21%) lost friends or neighbours during the earthquake. Fifty-nine (38%) survivors reported having had exposure to a life-threatening experience other than the 1999 earthquake (e.g. fire, traffic accident), and 93 survivors (59%) had also experienced the 1981 Alkyonides earthquake in Athens (magnitude 6.8 Richter).

With regards to the survivors' intensity of fear during the earthquake, two (1%) reported 'none', 12 (8%) 'mild', 30 (19%) 'moderate', 52 (33%) 'severe' and 60 (38%) 'extreme' fear.

Comparisons between men and women showed no differences in most demographic and trauma features. However, women were less likely to have participated in rescue work

(7% vs. 22%, $\chi^2$ = 5.1, df = 1, $P$ < 0. 05), and compared to men's fear during the earthquake (Mean = 2.6, SD = 1.0), women's fear (Mean = 3.3, SD = .87) was significantly more intense ($t$ = –4.5, df = 154, $P$ < 0. 001).

### 3.2. Internal consistency and factorial structure of the TSSC

Reliability analyses were conducted on three subsets of items: (a) all 23 items, (b) 17 PTSD items, and (c) six depression items. All three analyses yielded satisfactory α values (0.94, 0.92, and 0.83, respectively). The mean item-total score correlations in the three analyses were 0.59 (range 0.21–0.74), 0.60 (range 0.21–0.75), and 0.61 (range 0.31–0.80), respectively. In all three analyses, there was no item the omission of which resulted in a substantial increase in the α value. These results are similar to those obtained in a previous validation study of the TSSC in Turkey [8].

Principal components analysis (PCA) was conducted to explore the factorial structure of the scale. The correlation matrices on which the PCA was based were suitable for analysis (KMO = 0.87, Bartlett's test of sphericity < 0.001). The exploratory analysis initially yielded four components with eigenvalues greater than 1 (altogether explaining 64% of the variance). Nevertheless, examination of the scree plot indicated that components' extraction could be limited to two. These two components (Table 1) appeared to be similar with those yielded in previous studies of Turkish earthquake survivors [7,24,35]. Component 1 (eigenvalue 10, 43% of variance explained) reflected PTSD, and component 2 (eigenvalue 2, 8% of variance explained) reflected depression. Thus, the factorial structure of the scale was similar to that yielded in Turkey where the TSSC proved to be a valid and useful diagnostic tool for earthquake-related PTSD.

### 3.3. Symptoms of PTSD and depression

Figs 1 and 2 show that a substantial proportion of the survivors experience symptoms of PTSD and depression 4 years post-earthquake.

According to the first calibration (symptom present if intensity ≥ 1), 56% of the survivors endorsed at least five and 35% of them at least 10 TSSC symptoms. Using the more stringent calibration (symptom present if intensity ≥ 2), 25% of the survivors endorsed at least five and 12% at least 10 TSSC symptoms. With regards to PTSD symptoms in specific, using the first more lax calibration, 55% of the survivors endorsed at least five and 27% at least 10 symptoms. Using the second more stringent calibration, 22% of the survivors had at least five and 7% of them at least 10 PTSD symptoms.

Seventy-one (45%) reported that their symptoms do not cause them any distress, whereas 46 (29%) reported 'slight', 27 (17%) 'marked', and eight (5%) severe distress. Ninety-seven survivors (62%) reported that symptoms do not interfere with their adjustment, whereas 33 (21%) reported that they interfere 'slightly', 22 (14%) 'markedly', and two survivors (1%) 'severely'.

Table 1.
Principal Components Analysis of the Traumatic Stress Symptom Checklist

| | Component | |
|---|---|---|
| | **1: PTSD** | **2: Depression** |
| Intrusive thoughts about trauma | .83 | |
| Flashbacks | .74 | |
| Hypervigilance | .73 | |
| Avoidance of trauma related thoughts | .72 | |
| Distress to reminders of the trauma | .72 | |
| Avoidance to reminders of the trauma | .70 | |
| Exaggerated startle | .66 | |
| Physiologic reactivity to trauma reminders | .65 | .41 |
| Problems with sleep | .61 | .43 |
| Memory and concentration problems | .57 | .41 |
| Nightmares | .56 | |
| Increased irritability | .55 | .44 |
| Loss of pleasure | | .73 |
| Loss of energy | | .72 |
| Emotional numbness | | .70 |
| Detachment | | .70 |
| Hopelessness | | .68 |
| Depressed mood | .47 | .66 |
| Guilt | | .57 |
| Loss of interest | | .55 |
| Sense of shortened future | .50 | .53 |
| Psychogenic amnesia | | |
| Suicide thoughts | | |
| % of variance explained | 43 | 8 |
| eigenvalue | 10 | 2 |

Only loadings > .40 are shown

### 3.4. Predictors of earthquake-related psychological distress

Multiple regression analyses (simultaneous entry method) examined the risk factors for post-earthquake psychological distress. The dependent variable was TSSC total scores and the independent variables were age, gender, education, marital status, personal or family history of psychiatric illness, past trauma experience, material loss, being in a building at the time of the earthquake (as opposed to being in the street or in a vehicle), participation in rescue work, currently living in a prefab, level of damage to home, loss of friends or neighbours, time since earthquake, experience of the 1981 Alkyonides earthquake, and intensity of fear during the earthquake. Being trapped under rubble and having lost first or second degree relatives in the earthquake were excluded from analyses because they were endorsed by less than five survivors.

The predictor variables explained 25% of the total variance in TSSC total scores (adjusted $R^2$ = 0.25, $F$ (16, 114) = 3.3, $P$ < 0.001). Higher TSSC scores were predicted by *greater fear during the earthquake* ($\beta$ = 0.33, $t$ = 3.5, $P$ < 0.01), and *participation in rescue work* ($\beta$ = 0.20, $t$ = 2.2, $P$ <.0 05).

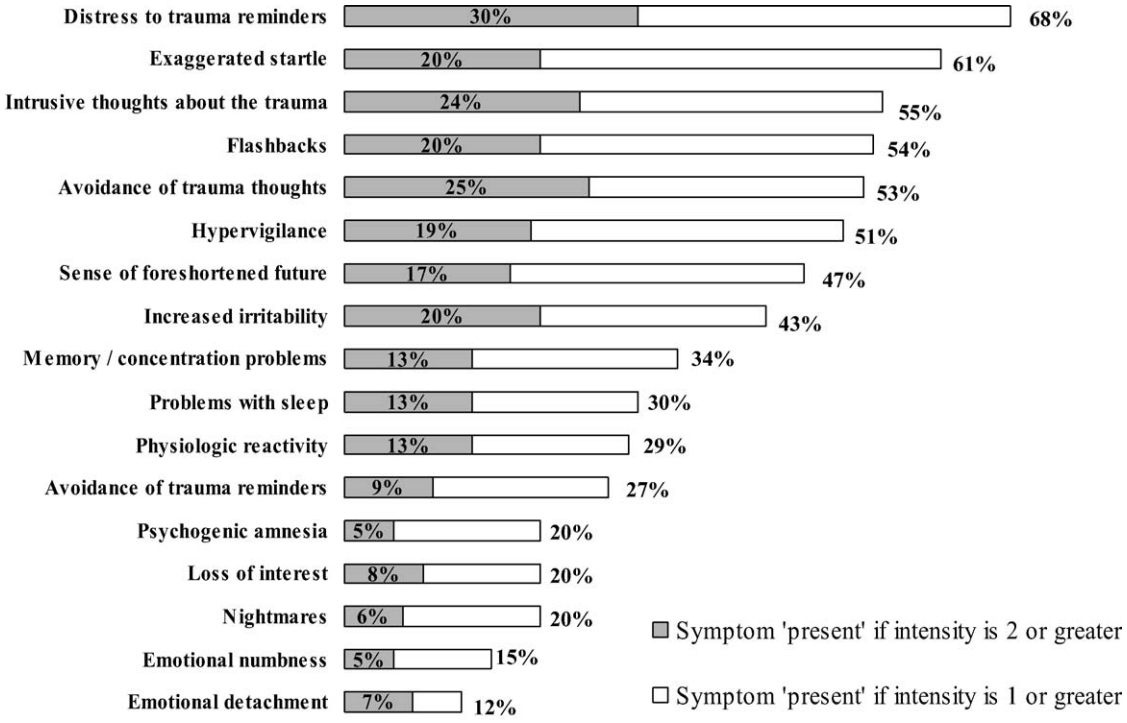


Fig. 1. Endorsement rate of PTSD symptoms.

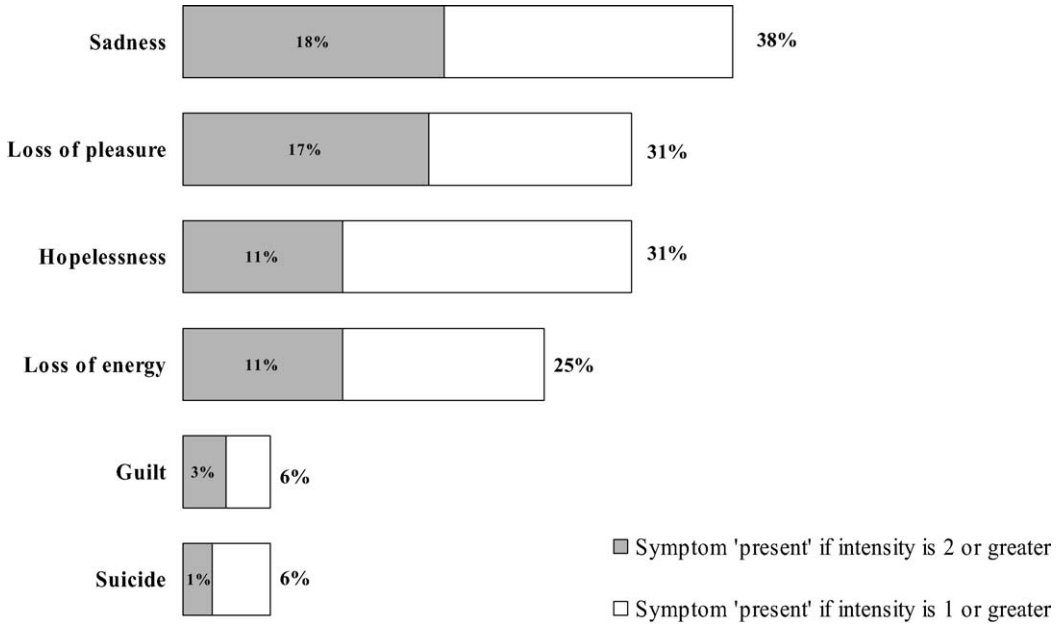


Fig. 2. Endorsement rate of depression symptoms.

As the retrospective rating of fear could be confounded by PTSD symptoms, we conducted a regression analysis to examine if other variables that would be expected to relate to fear during the earthquake actually predicted the latter. Age, gender, education, being in a building during the earthquake, and the TSSC scores were used as independent variables and the intensity of fear during the earthquake as the dependent variable. The TSSC scores were included in the analysis to control for the possible confounding effects of PTSD symptoms on the retrospective rating of fear. If fear merely reflected a confound of PTSD symptoms, then the other potential predictors of fear would not be expected to explain significant independent variance in the fear ratings. The regression analysis yielded a significant prediction model (adjusted $R^2 = 0.23$, $F(5, 122) = 8.2$, $P < 0.001$). Greater fear during the earthquake was associated with *higher TSSC – total scores* ($\beta = 0.33$, $t = 3.9$, $P < 0.001$) and *female gender* ($\beta = 0.28$, $t = 3.3$, $P < 0.01$). These findings suggested that the fear ratings may not entirely reflect a possible confound of PTSD symptoms.

## 4. Discussion

Unlike some of the previous studies that involved survivors of earthquakes that caused widespread devastation and thousands of deaths [20,35] our results were based on survivors with relatively less earthquake exposure (e.g. none of the participants had lost a first-degree relative during the earthquake, two participants lost a second degree relative, and only one participant had been trapped under rubble). Nevertheless, our findings suggest that a substantial number of those exposed to an earthquake of relatively low intensity may still experience symptoms of traumatic stress 4 years after the earthquake. In addition, 22% of the survivors reported moderate or severe subjective distress due to their earthquake-related symptoms and 16% that their symptoms interfered markedly or severely with their social, occupational, and personal adjustment. These findings are consistent with those of previous studies [14,20,35] showing that the psychological consequences of earthquakes can be long-term.

The association between fear and earthquake-related psychological distress is consistent with findings from a previous study of survivors of the 1981 earthquake in Athens [10] which compared survivors who had returned in their homes to those who still lived in tents 2–3 months after the earthquake. In that study the survivors who still lived in tents were more anxious and reported (retrospectively) significantly greater fear during the earthquake. The association between fear and post-earthquake psychological distress is also consistent with results from studies based on survivors of the 1999 Marmara earthquake in Turkey [7,24,35]. The present study however, replicated these results in a context of an earthquake that had considerably milder impact on the community. It is of interest that fear should re-emerge as the strongest predictor of earthquake-related psychopathology in a sample that is not fully representative of a population exposed to a major disaster (e.g. the survivors of the Marmara earthquake in Turkey who had suffered greater material loss and bereavement). In addition, the Turkish studies were conducted from 8 to 20 months post-earthquake, whereas the present results emphasise the association between fear during the earthquake and long-term psychological distress (45 months post-earthquake).

The relationship between participation in rescue work and TSSC total scores was relatively small, albeit significant. It is important to note that the study participants who got involved in rescue work were not professional rescuers but citizens from the affected community who rushed to offer their help when it was needed. These people did not have special training or experience in rescue work and may have thus been less psychologically prepared in the face of the stressors that they experienced. Lack of psychological preparedness for trauma is a known predictor of PTSD [6].

The results of this study need to be interpreted with caution in the light of the study's methodological limitations. As in other studies that involve retrospective ratings, bias may have influenced the survivors' ratings of fear during the earthquake. The survivors' recall may have been affected by other non-PTSD related factors (e.g. natural alterations in the cognitive-neural structure itself) and thus information provided to us about events occurring 4 years previously may not be entirely accurate. Furthermore, as the study did not involve a probability sample it is difficult to draw conclusions about the rates of earthquake-related PTSD and depression in the general population. In addition, the high refusal rate poses another obstacle in the generalisability of the results.

A more important limitation of the study concerns the lack of information about the validity of the Greek 1-monthly version of the TSSC. For this reason, the estimated rates of PTSD and depression symptoms reported in the current study may be overrated. Indeed, self-report scales are known to overestimate PTSD [12]. Nevertheless, in the absence of standardized and validated diagnostic instruments or self-report diagnostic measures of PTSD in Greece, the Greek version of the TSSC was considered the best available option as it also allowed some tentative comparison with previous studies of earthquake survivors [7,8,24,35]. Furthermore, the scale was shown to have high internal consistency, and the two factors yielded by the principal components analysis were similar to those yielded in studies using the validated Turkish version of the TSSC [7,24,35]. These considerations suggest that the TSSC may be useful in detecting earthquake-related psychological distress and warrant the planning of a validation study to examine more accurately the diagnostic validity of its Greek version.

In the course of the present study we came across a previously reported observation concerning earthquake survivors, namely their reluctance to seek help for their psychological distress [15,16]. Some of the symptomatic survivors stated that they perceived their earthquake-related problems as justifiable and normal, given that earthquakes are life-threatening events. Others were unaware that certain psychological interventions are effective in reducing earthquake-related psychological distress. Our results offer some indirect support to the notion that absence of help seeking should not be construed as absence (or low incidence) of earthquake-related psychopathology. Based on similar observations from earthquake survivors in Turkey, it has been suggested [8] that mental health policies for earthquake survivors need to be 'outreach'. This suggestion seems to be relevant also to post-earthquake mental health policies in Greece.

Given that fear was the strongest predictor of post-earthquake psychological problems not only in studies of survivors of major earthquakes [7,24,35] but also in the present study, psychological interventions that reduce fear of earthquakes and instil emotional resilience to earthquakes in the survivors may be helpful in preventing the development of PTSD symptoms. Such interventions comprise cognitive-behavioural treatments that have been proven to be effective in reducing PTSD resulting from various types of trauma [23]. Indeed, there is recent evidence that brief behavioural treatments are very effective in reducing earthquake-related

fear and PTSD [3,4] and could be implemented in countries that are likely to experience frequent, albeit less destructive earthquakes, such as Greece. In addition, the association between fear and female gender has to be taken into consideration when mental health policies for earthquake-survivors are planned on a government level.

## 5. Conclusion

Four years after the Parnitha earthquake some survivors still experience bothersome symptoms of PTSD. Fear during the earthquake is a predictor for post-earthquake psychological distress and thus any attempts to prepare populations in earthquake-prone regions need to be based on psychological strategies that have been proved to reduce peoples' fear during the earthquake. In addition, governments need to consider the planning of long-term mental health policies for the survivors and such policies need to be based on an 'outreach' model.

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